# Towards Intelligent Condition Monitoring
# A Framework for Next-Gen Vibration and Combustion Analytics
# Case Study- Uniper Leiden GT2

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The beating heart of energy.

# Introduction

**Catastrophic Risks:**

- *"Sudden blade loss/damage in **fractions of a second**."*
- *"Unplanned downtime, **$XX million** repairs, safety hazards."*

**Traditional Monitoring Gaps:**

- *"Misses transient anomalies (low-frequency thresholds)."*
- *"Reactive, not predictive."*

**Call to Action:**

*"Urgent need for **intelligent, real-time solutions**."*

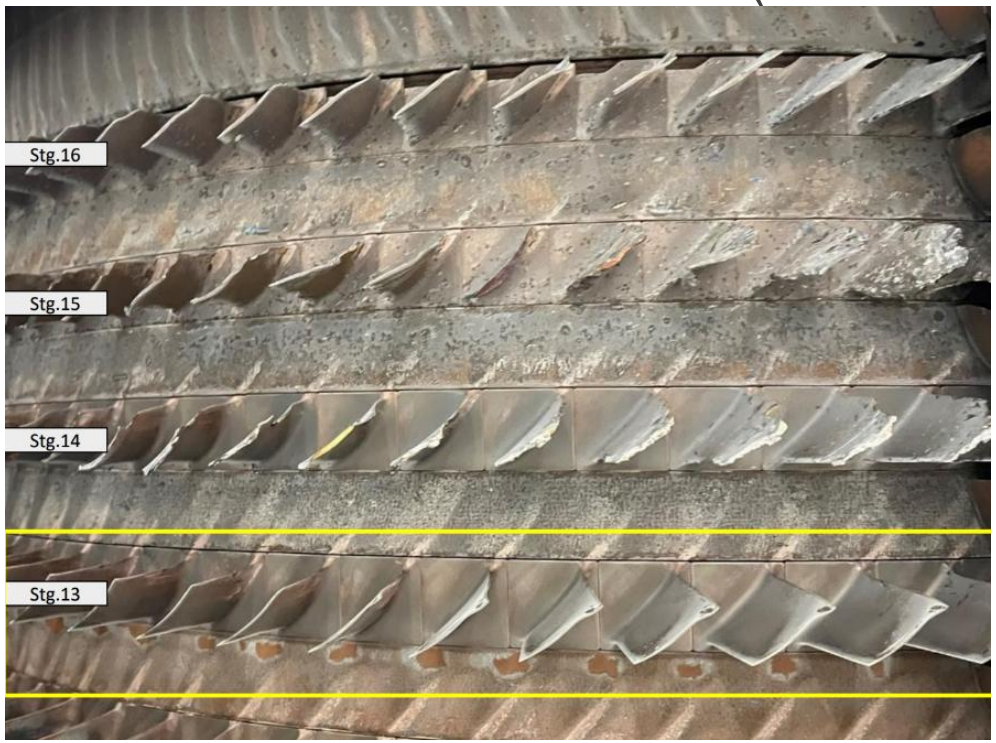
- ***"How would your current systems handle this type of failure?"***

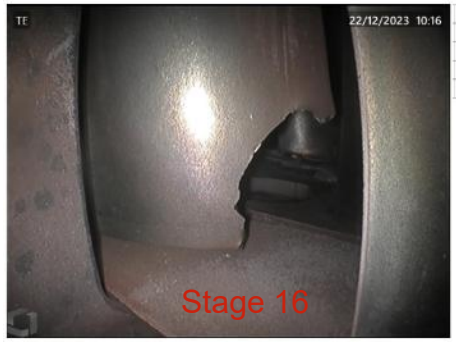
# Failure Sequence

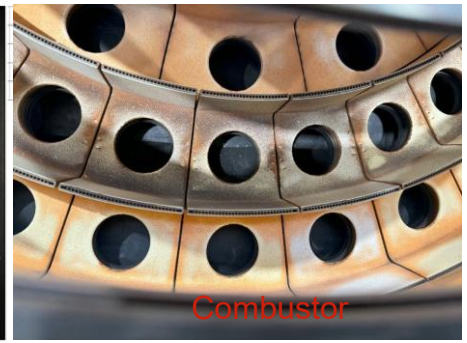
- Multiple failed restarts (4–5 attempts, tripped at ~6000 RPM / 10k RPM machine).
- No vibration alarms triggered in DCS (levels below thresholds).
- **Only clue:** Balancing piston pressure spike during event.

# RCA Findings

- 2 blades from stage 13 liberated
- High cycle fatigue (HCF) IN HPC Stage 14,15 & 16
- No clear combustion anomalies (EGT/inlet temp normal).

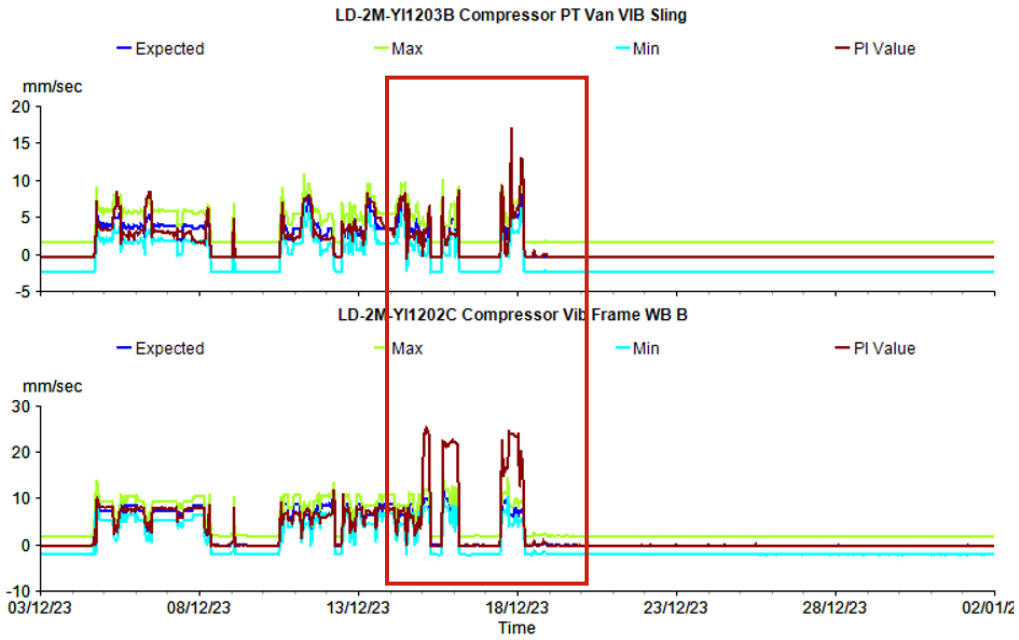


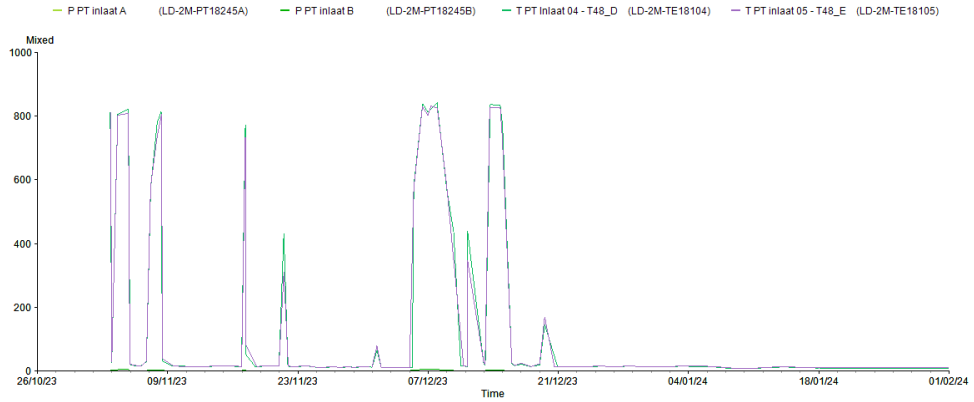



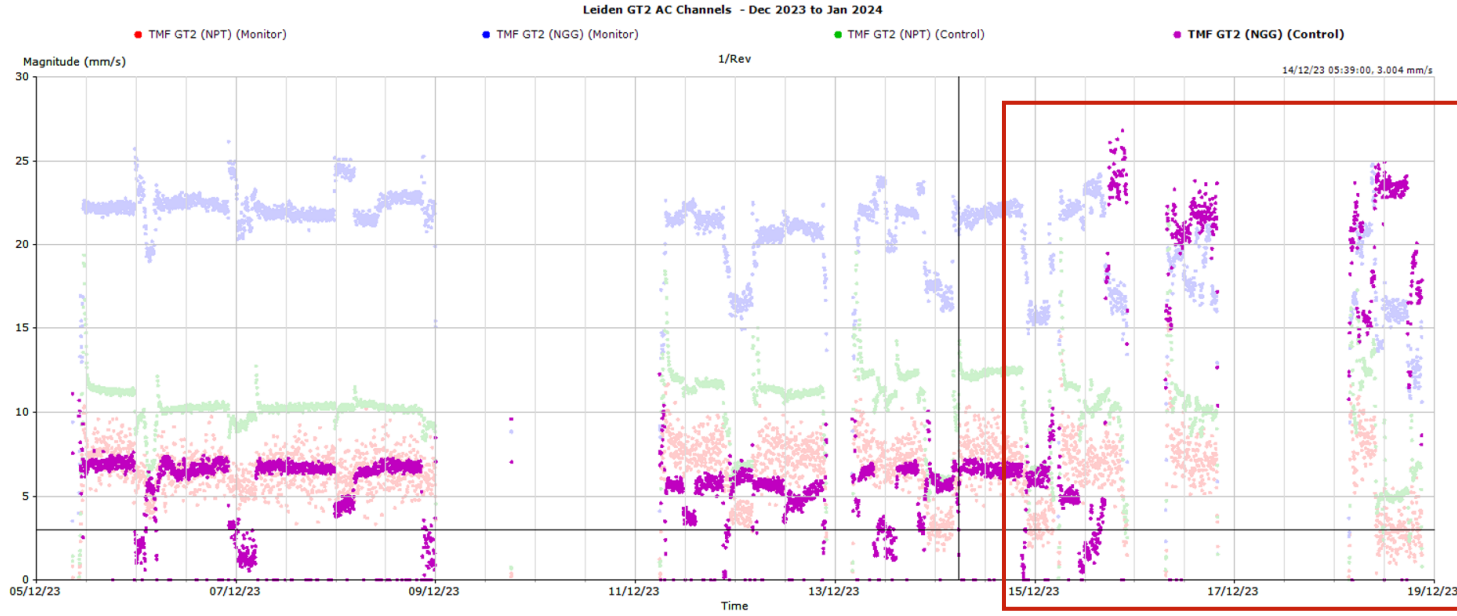




| Area | Observations |
|---|---|
| Row 01 - 12 | No obvious damage |
| Row 13 | Bleeds are clear no obvious signs of problems, 2 vanes missing by split line one half. Second half on area adjacent to missing vanes evidence of vane damage and crack could be impact. Damage to trailing edges. Evidence of material smearing between stages |
| Row 14 | Damage to all vanes evidence of material smearing in between stages |
| Row 15 | Bent and damaged vanes from impact evidence of material smearing between stages |
| Row 16 | Damaged vanes due to impact mostly located on leading and trailing edges |

# What we know!



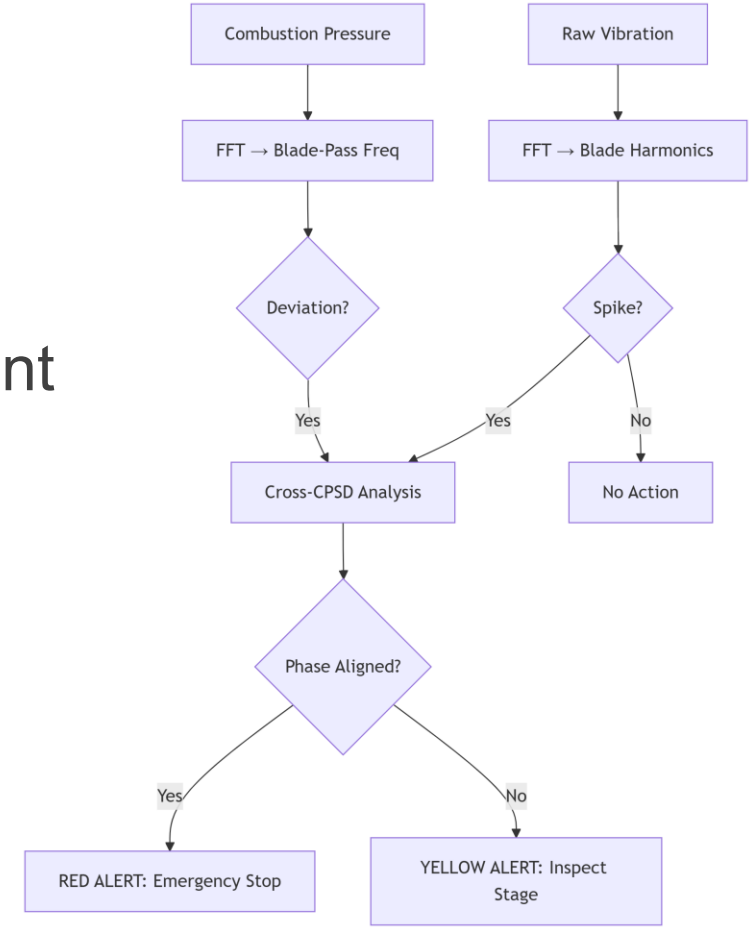





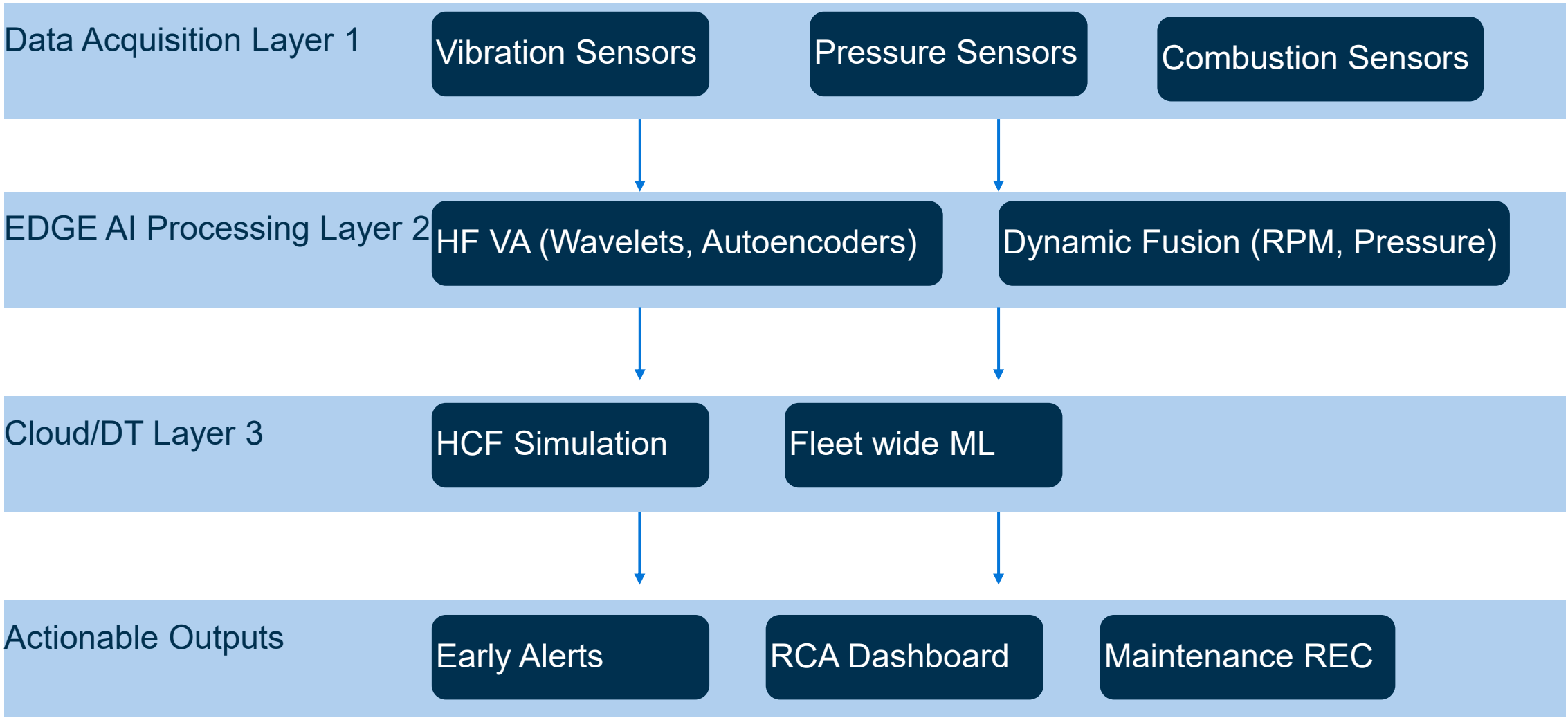

Online Vibration Monitoring System

# Intelligence Relevance

- Overcomes single-source blind spots)
- Distinguishes between failure modes (e.g., airflow disruption vs. pure mechanical fault)
- Enforcing cross-domain causality—critical for transient events



# Proposed Detection Framework – Next Gen



***RCA did not find the cause!***

***"Where should we prioritize our efforts?"***

***Thank You, Any Questions?***